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(54) **Vibratory therapy apparatus**

(57) Vibratory therapy apparatus in which the speed of vibration is varied in a regular periodic manner. The apparatus has an electric motor with an off-set weight mounted on its axis to give cycloid vibrations and the speed of the motor is controlled with a variable resistor. A relay operated by an oscillator alternately cuts out the variable resistor to give a regular variation in the speed of vibration.

The drawings originally filed were informal and the print here reproduced is taken from a later filed formal copy.

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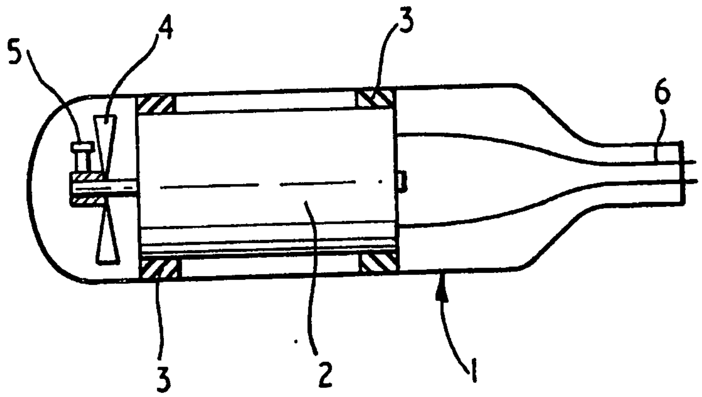



FIG.1.

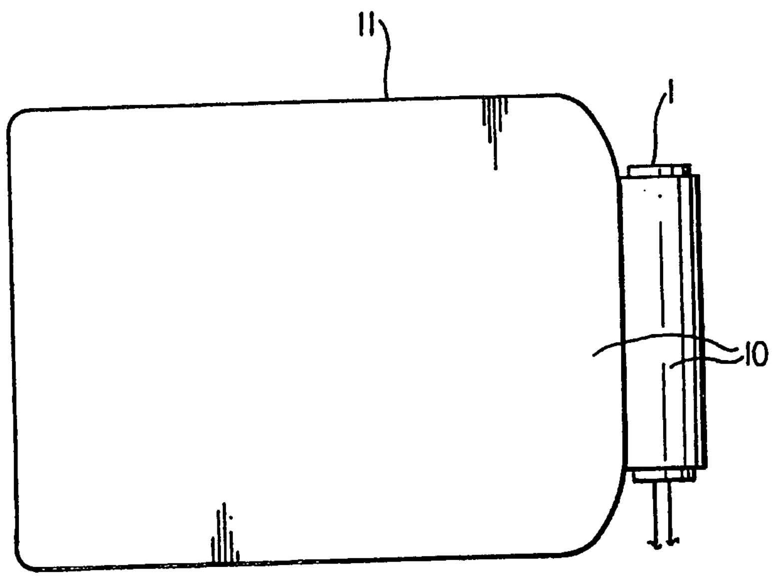
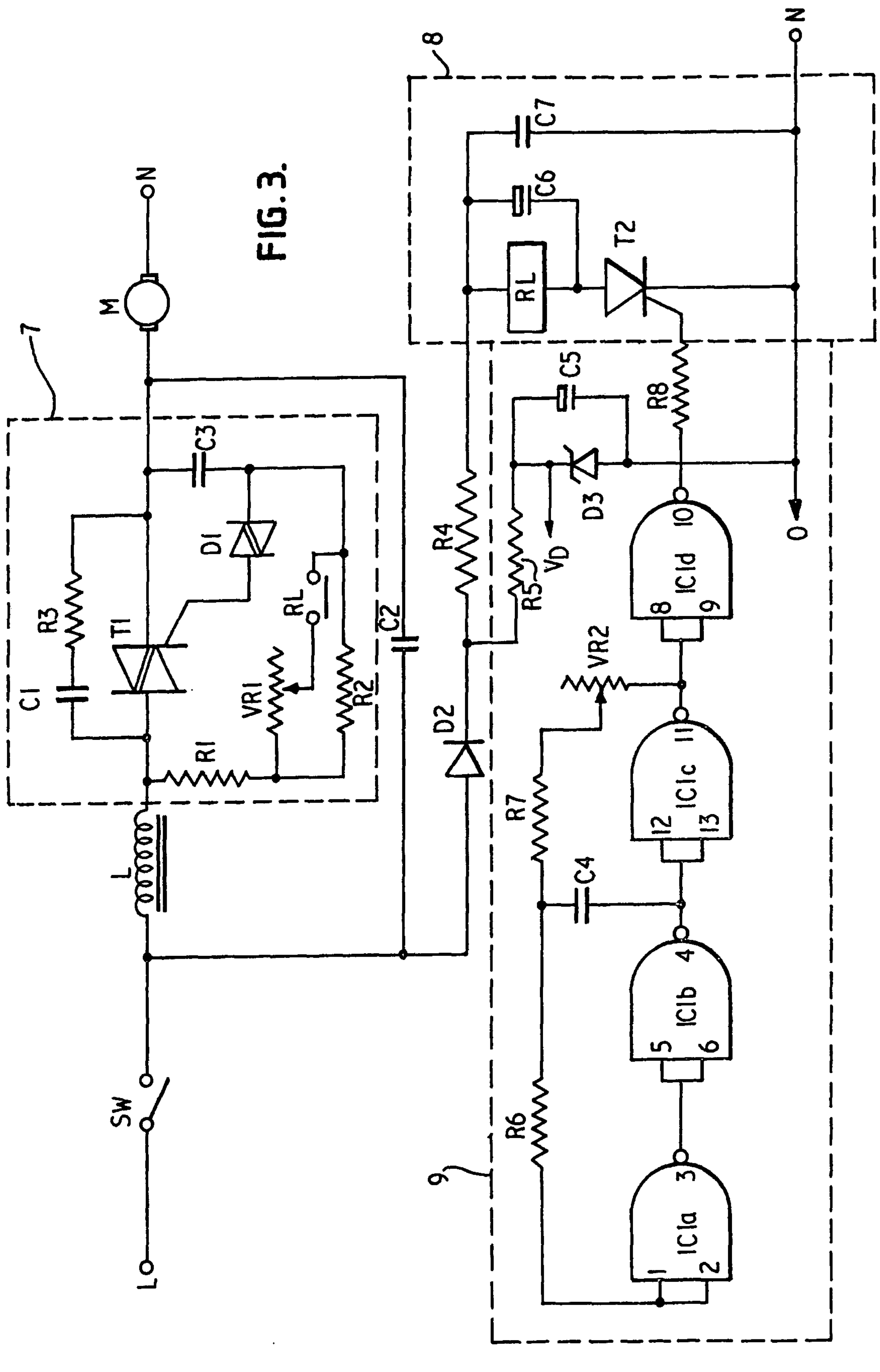



FIG.2.



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R3
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C7
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R6
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C4
VR2
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IC1b
IC1c
IC1d
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FIG. 3.

SPECIFICATION
**Vibrat ry therapy apparatus**

The present invention relates to vibratory therapy apparatus and in particular to apparatus employing cycloid vibrations.

Vibratory therapy apparatus is known to be useful in the treatment of various medical conditions and particular benefit has been obtained in the areas of, post-operative treatment, muscle relaxation, alleviation of Rheumatic pain, clearance of mucous and treatment of retarded children when using cycloid vibratory apparatus. In a cycloid vibrator a motor is normally resiliently mounted in a housing with an off-set weight fitted on to the shaft of the motor. Rotation of the motor produces vibration in three separate planes (cycloid vibration), the motor being able to move slightly against its resilient mounting in any direction. Both the frequency and amplitude of vibration can be varied by controlling the speed of the motor and suitable values are selected to give the optimum benefit in any given treatment. The vibrator can be hand held or incorporated into a larger therapy apparatus such as a pad, chair, bed, or massage table.

It has however been found that in some circumstances repeated treatment with cycloid vibratory therapy apparatus produces a resistance to the treatment which gradually reduces its effectiveness. The reason for this build up of resistance is not fully understood but it can reduce the usefulness of the conventional cycloid vibratory therapy apparatus.

According to the present invention there is provided vibratory therapy apparatus comprising a mechanical vibrator and control means capable of varying the speed of vibration of the vibrator in a regular periodic manner.

The apparatus according to the present invention reduces the incidence of resistance to treatment and increases the range of treatment which can be provided.

Vibratory therapy apparatus constructed in accordance with the present invention will now be described by way of example and with reference to the accompanying drawings in which:

Figure 1 is a view of the inside of a cycloid vibrator:

Figure 2 is a view of a therapy apparatus incorporating a cycloid vibrator of the type shown in Figure 1; and

Figure 3 is a circuit diagram of a control circuit for the cycloid vibrator shown in Figure 1.

Referring to Figure 1, the cycloid vibrator for the apparatus comprises a cylindrical housing 1 of metal or plastics material in which is mounted an electric motor 2. The motor is supported in the housing 1 by two soft rubber rings 3 which allow the motor to move slightly in the housing. On the spindle of the motor is mounted a cooling fan 4 and an off-set weight 5. The motor is connected to a control circuit by wires 6.

When the motor is energised by the control circuit, the off-set weight 5 causes the motor to vibrate in its housing 1, the rubber rings allowing vibration in three separate planes. This is called cycloid vibration and the frequency and amplitude of vibration depend on the speed of the electric motor.

The circuit diagram of the control circuit is shown in Figure 3 and comprises a speed controller 7 connected to an AC/DC universal series motor M, a switching circuit 8, and a multivibrator 9. The speed controller 7 is of a conventional type in which the current through the motor is controlled by a Triac T1 which is triggered into conduction by a diac D1 at a point in each cycle of the mains voltage determined by the voltage drop across resistors R1, R2 and VR1. VR1 is a variable resistance and as VR1 is increased the voltage drop across R1, R2 and VR1 increases causing the diac D1 to trigger T1 later in the mains voltage cycle. This reduces the time for which T1 is conducting in each cycle and hence reduces the overall current to the motor M, causing the motor speed to drop. The minimum controlled motor speed which is approximately 1,000 rpm occurs when VR1 is at its maximum and the maximum speed of approximately 3600 to 6500 rpm when VR1 is at its minimum. The maximum speed depends on the size of the off-set weight 5.

Connected in series with the variable resistance VR1 are the contacts of a relay RL such that when the contacts open the resistance VR1 is isolated and the motor speed, determined by R1 and R2, falls below the minimum controlled motor speed.

The coil of the relay RL is connected through a diode D2 and a thyristor T2 across the mains supply, the voltage on the trigger electrode of the thyristor T2 which controls the operation of the relay, being determined by a multivibrator 9 connected to the trigger electrode by resistor R8.

The multivibrator comprises four NAND gates IC1 *a, b, c* and *d* connected in series, with feedback resistors R6, R7 and VR2 and capacitor C4 to control the frequency of oscillation of the output. Variable resistor VR2 enables the frequency of oscillation to be varied from 20 to 60 cycles per minute. A regulated power supply for the NAND gates is provided by the zener diode D3 with its resistor R5 and capacitor C5, giving a voltage $V_D$ suitable for the integrated circuit bearing the NAND gates.

When the relay RL is energised by the thyristor T2 being triggered by the multivibrator, the relay contacts close and the current through the motor $M_1$ is that set by the selected position of VR1. This causes the motor speed to increase, the rate of acceleration being determined by the current and the value of the offset weight chosen, towards the set speed. After a period determined by the frequency of the multivibrator 9, the relay is de-energised and the relay contacts open again causing the current through the motor to fall to the minimum value. This causes the motor speed to decrease, the rate of deceleration being determined by the current and the value of the offset weight, towards the minimum value. Thus the motor speed is modulated by the multivibrator.

If the frequency of the multivibrator set with VR2 is low then the motor will have time to reach both its set speed and its minimum speed between accelerations and decelerations but if the frequency is high enough the motor will have to continually accelerate and declerate due to the inertia of the off-set weight and the degree of variation in its speed will then be determined by the frequency of the oscillations set with VR2 as well as the value of the speed set with VR1.

A vibratory therapy apparatus incorporating the cycloid vibrator of Figure 1 and its control circuit of Figure 3 is shown in Figure 2, where the housing 1 is attached to a plate (not shown) inside a foam rubber pad 11, the pad 11 and vibrator 1 being covered in a sleeve of material 10. The pad 11 allows the vibrations to be applied to a larger area than would the single vibrator 1. Other forms of apparatus incorporating a mechanical vibrator and control means according to the invention are also possible, such as beds, massage tables and other patient supporting structures.

The modulated cycloid vibrations produced by the described apparatus have been found to reduce the resistance to treatment arising with conventional apparatus, and the greater range of treatments available with the use of a modulation control as well as a motor speed control are of benefit in adapting the apparatus to each individual user.

While the apparatus has been described with a vibrator using an electric motor and an offset weight to produce cycloid vibrations, the vibrator could be replaced by a solenoid and armature bell type mechanism or a pneumatic motor and offset weight or any other suitable mechanical vibrator whose speed of vibration can be controlled.

Also various speed controllers could be used other than the triac/diac configuration described above using silicon controlled rectifiers or other devices such as a rheostat, a stepper switch and resistance bank, a stepper motor operated switch and resistance bank, or where the motor is pneumatic on air control value, and the modulation of the speed can be produced in various ways such as a motor operated rheostat, or a motor driven cam operating a micro-switch in the circuit or a solenoid operated switch. During modulation the motor current could be increased and decreased gradually by the control circuit rather than simply switching it between high and low currents and relying on the intertia of the motor as in the present construction.

CLAIMS

1. Vibratory therapy apparatus comprising a mechanical vibrator and control means capable of varying the speed of vibration of the vibrator in a regular periodic manner.

2. Vibratory thereapy apparatus according to claim 1, wherein the frequency of the periodic variation in speed of vibrations is adjustable.

3. Vibratory therapy apparatus according to claim 1 or claim 2, wherein the maximum speed of vibration is adjustable.

4. Vibratory therapy apparatus according to any preceding claim, wherein the control means switches the vibrator periodically between present minimum and maximum speeds, the rate of change of speed being determined by the inertia of the mechanical vibrator.

5. Vibratory therapy apparatus according to any preceding claim wherein the mechanical vibrator comprises a rotary motor resiliently supported in a housing and having an axially off-set weight mounted on its spindle, the speed of vibration depending on the rotational speed of the motor.

6. Vibratory therapy apparatus according to claim 5, wherein the motor is an electric motor operable by an A.C. mains supply and the control means comprises a semiconductor switching devide connected in series with the motor which conducts when the mains supply voltage exceeds a threshold value, an oscillator and switching means operable by the oscillator to vary the output of the potential divider.

7. Vibratory therapy apparatus according to claim 6, wherein the switching means is a relay whose contacts are connected in series with one of two parallel branches of the potential divider.

8. Vibratory therapy apparatus substantially as herein described with reference to and as illustrated by the accompanying drawings.

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